P Lambe

HERE'S HOW YOU

CAN

DO IT IN

SCIENCE

BIOLOGY

CHEMISTRY

GEOLOGY

PHYSICS

HERE'S HOW YOU CAN DO IT IN SCIENCE

COMPILED BY ANNE SKINNER

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HERE'S HOW YOU CAN DO IT IN

BIOLOGY

Section 1.

HERES HOW YOU CAN DO IT IN

BIOLOGY

CONTENTS

STUDYING MICRO-ORGANISMS: YEAST (SEN 1979, Vol. 28 No. 4)

Lyn Thickett, Wiley Park G.H.S.

In both the Senior and Junior schools, the concept of a micro-organism is taught and is usually accompanied by experiments involving the growing of micro-organisms from various sources on agar plates. Because of the possibility of summoning up a pathogen during this process, it is safer to use a 'tame' micro-organism, in this case yeast. (The experiment is even more memorable if the 'experimentee' gets eaten at the end of the day by the experimenter).

Junior Experiment

Aim

To observe the activity of a micro-organism when given ideal conditions in which to live.

Method

1. In a 400mL beaker cream together 30g of yeast (live) with 50g of sugar.
2. Add 200mL of warm water and stir well.
3. In a second 400mL beaker place 50g of sugar and enough warm water so that the level in this beaker is equal to the level in the first beaker.
4. Stand both beakers in a warm place and observe what is happening.

Results

1. Describe the initial appearance of the contents of the two beakers.
2. After several minutes, what can you see happening? What can you hear? What can you smell?
3. At the end of twenty minutes, is there a difference in the mixture levels?

Conclusions

Your conclusion to this experiment should contain answers to the following questions.

1. What is the function of the sugar?
2. Why did the water need to be warm?
3. Suggest two ways in which yeast could be prevented from growing.

This is a strict science experiment, but if the students want to eat the yeast in the form of bread, the whole experiment can be carried out using clean jam jars and cooking equipment. The above experiment will occupy a 40 minute period, but if bread (or any yeast recipe) is to be made, the teacher must be willing to spend several hours after this lesson while the recipe proves. Alternatively, the students may like to take their yeast culture home and make bread for the family.

Simple Bread Recipe

Place 4 cups of plain flour, 1/2 cup of powdered milk and salt in a large basin. Make a well in the middle of the flour, add the yeast mixture and another 1/2 cup of warm water. Mix to a soft dough and then knead on a floured sheet for 5 minutes. Place on greased trays and allow to rise until double in size. Cook in a hot oven until golden brown.

Senior Experiments

The senior experiments involve:

(a) the rate of production of gas by the yeast as it grows
(b) the determination of the gas given off
(c) microscopic examination of the yeast.

Method

The same as in the junior experiment up to step 3.

(a) Rate of production of gas
  1. Transfer 100mL of the yeast mixture to a small flask, fitted with a stopper and delivery tube.
  2. Collect the gas produced by the downward displacement of water in a 10mL measuring cylinder.
  3. Record the amount of water displaced every 10 minutes for at least 60 minutes, then after 2 hours, 3 hours, etc.
  4. Plot a graph of rate of production of gas.

(b) Determination of gas given off
  1. From the remaining solution, transfer 50mL to another flask fitted with a delivery tube.
  2. Pass the gas produced over limewater.
  3. Record observations and state conclusion.

(c) Microscopic observation
  1. Dilute 1mL of the remaining yeast solution with 9 mL of water.
  2. Make a wet mount of some of the dilute solution.
  3. Sketch the appearance of the yeast organism.

Questions

Sometimes bakers produce breads called 'sour-dough' breads. Describe how this bread is made.

Facts About Yeast

Fresh live yeast should have a creamy beige colour and a firm consistency which crumbles easily when broken up. It can be stored in plastic in a cool place for up to 5 days, in a refrigerator for up to one month or in a freezer for up to one year.

Do not cream yeast too much as this results in the breakdown of living yeast cells. Dried yeast can be used but results are often slow as the yeast has to be reactivated first.

EXPERIMENTS FOR 2 UNIT BIOLOGY ELECTIVES
(SEN 1980, Vol. 29 No. 4)
Pat Funnell.

The following experiments require no special equipment, would take students only a short period of time to set up in class and would not require hours of preparation on the part of the laboratory assistant. Results are rapid, so the entire procedure and discussion can be completed within the normal double practical period.

A. Rates of Oxygen Production During Photosynthesis

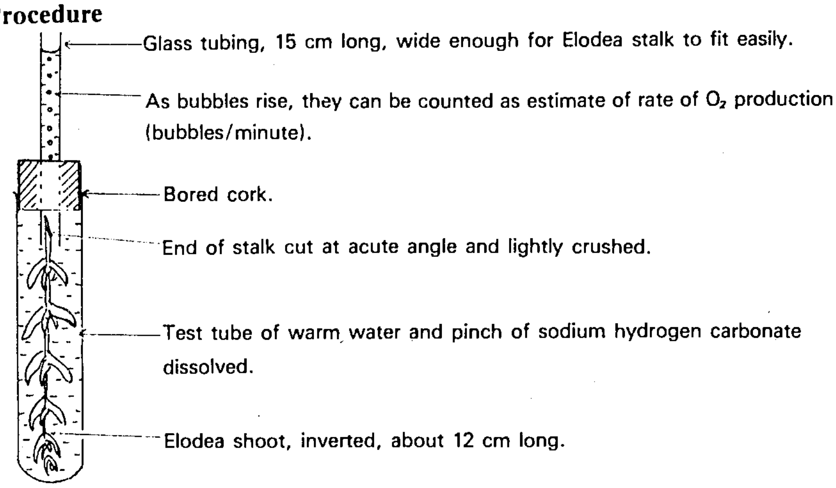
Introduction

In these experiments, easily assembled apparatus is used to test the influence of various environmental factors on the rate of gas production in *Elodea*. Such factors as light intensity, temperature and presence of hydrogen carbonate ions can be studied.

Materials per group

- 10 large test tubes
- 10 corks, bored, each with a length of glass tubing, 7-8mm in diameter, 15-16cm long
- 10 *Elodea* shoots
- 6 beakers, 6 thermometers (groups can share these)
- 1 scalpel or razor blade
- stop watch or clock for timing
- light meter (optional)
- sodium hydrogen carbonate.

Procedure



Procedure

Each group should select the required number of *Elodea* stalks all of the same lengths and condition. Remove leaves from the lower 2 or 3 nodes. Cut the stem at an acute angle and crush the end lightly with the flattened scalpel blade. Insert the cut end of the stem into the glass tubing so that it fits loosely, then lower into a test tube of lukewarm water. (Results are best if water is hand-warm or around 30^{o}C.) Raise the water level in the glass tubing as the cork is inserted in the test tube so that bubbles have approximately 5-10cm to rise above the cork: this makes counting easier. It may be necessary to suck on the open end of the glass tubing while inserting the cork in order to adjust the level of the water, so that the end should be flamed smooth.

Set up all the test tubes, then allow 5-10 minutes before starting to count the bubbles as they rise from the cut end of the stem. As a control, set up one test tube of *Elodea* from which all the leaves have been carefully removed.

Notes

1. If it is necessary to move the apparatus, try not to shake or disturb, as it appears that a high concentration of oxygen in the water is necessary before bubbling will occur from the stem.
2. A pinch of sodium hydrogen carbonate added to the water in each test tube when setting up will increase the speed of the reaction.
3. If *Elodea* is not available, try using another water weed with aerenchyma, such as *Valisneria*.
4. Each group should standardise their cutting and crushing technique in an attempt to get bubbles of approximately equal size.
5. If no bubbles emerge from the stem, as happens rarely, repeat cutting and crushing procedure.
6. In some cases, bubbling is so rapid students will need to be competent at keeping a tally.

Experiment 1. Influence of Light Intensity on Rate of Gas Production in *Elodea*

Follow the procedure above to set up 3 test tubes (plus control). Place each in a beaker of lukewarm water at identical temperatures. Place a thermometer in each beaker to record 'environmental temperature' at beginning and end of the experiment. Place the control in the beaker with the best illuminated test tube.

Method A
Place beakers at different distances from microscope lamps; 5cm, 10cm, 20cm. (Several groups can share a beaker and a lamp). Assume an inverse relationship between light intensity and distance from the lamp. Count bubbles emitted for 10 minutes.

Method B
Choose sites with 3 different light intensities, such as bright (e.g. window sill not in direct sunlight), medium and dimly lighted. A light meter can be used to measure light intensities, or qualitative estimates can be made. Count bubbles for 10 minutes.

Method C
Use one set of apparatus only and count bubbles emitted when it is placed in each of the 3 sites suggested in Methods A or B. Record bubbles per minute. Record environmental temperature for each test tube before and after each count.

Experiment 2. Influence of Temperature on Rate of Gas Production in *Elodea*
Follow the procedure above to set up 4 test tubes (plus control). Place each in a beaker of water at a different temperature. Wait 10 minutes approximately, for temperature within the test tube to approach that in the beaker, then count the bubbles for 10 minutes. Record environmental temperature at the beginning and end of each count. (Groups can share a beaker.)
Suggested temperatures:

- ice water
- room temperature
- warm water (about 30-40^{o}C)
- hot water (about 60-80^{o}C).

Precise temperatures are not important. To maintain high temperatures a water bath will be necessary. Have the control with the test tube in warm water or at room temperature.

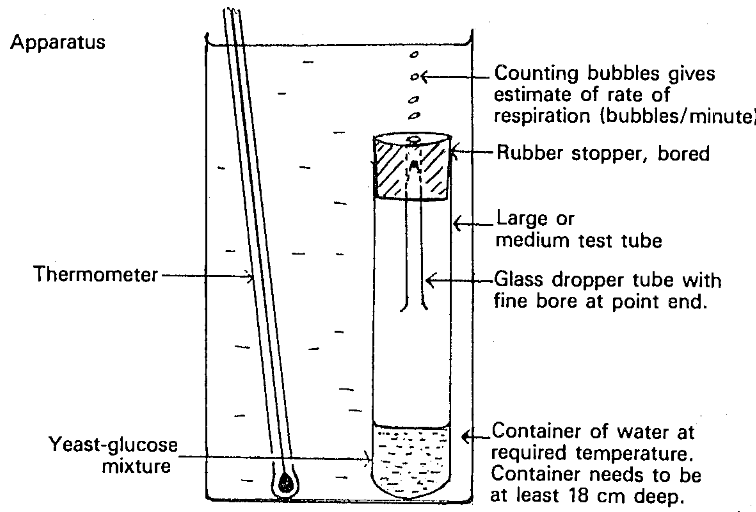
Record bubbles per minute. Record temperature before and after counting. Students can graph results.

Experiment 3. The Influence of Hydrogen Carbonate Ions on the Rate of Gas Production in *Elodea.*
Follow the procedure to set up 3 (or more) test tubes. Vary the concentration of sodium hydrogen carbonate solution in each test tube. Suggested concentrations:

- tap water only
- 0.5% solution
- 5% solution.

The class might wish to try higher concentrations or to test the influence of other ions. Ensure each test tube is at the same temperature and under the same light intensity.

B. Rates of Respiration in Yeast



(Adapted from *Laboratory Biology. Investigating Living Systems.* Albert Kaskel, Paul J. Hummer Jr., James E. Kennedy, Raymond F. Oram. Charles E. Merrill Publishing Co. Columbus, Ohio, 1979.)

Notes

The stopper and dropper tube must fit firmly. The opening of the glass tube must be well above the yeast glucose mixture. The outer container must be at least 18cm deep. Some suggestions include:

* 1L or 2L milk cartons or juice cartons
* plastic soft drink bottles with the top cut off
* large coffee jars or storage jars on issue to schools

Materials per Group

5 or more sets of test tubes
5 or more sets of rubber stoppers
5 or more sets of dropper tubes
1 thermometer 50 or 110^{0}C
1 large container for water bath
(where the influence of temperature is to be studied, groups will require 1 thermometer and 1 container per temperature, but these can be shared by several groups)
approximately 10g compressed yeast
1 balance
100mL of glucose solution, 10%, made up using cooled boiled tap water (except where influence of substrate is to be studied, concentration of glucose

solution need not be accurate. one teaspoon per 100mL is sufficient)

1 x 10mL pipette

ice, hot water, cold water

additional solutions for specific experiments.

Experiment 1. Influence of Temperature on Rate of Respiration of Yeast

Procedure

Place 2g of solid compressed yeast in each of 5 test tubes. Pipette 10mL of approximately 10% glucose solution into each test tube and shake well.

Prepare 5 water baths at different temperatures, e.g.

ice water at 0°C

cool, room temperature, i.e. 20°C

warm, 35°C

hot, 60°C

very hot, 80°C.

Ensure stoppers are firmly in place, then place one set of apparatus in each container of water. Wait 2 minutes for the temperature within the test tube to reach the environmental temperature. Tally bubbles for, say, 10 minutes. Record temperature at commencement and at conclusion of counting. A control test tube without yeast could be set up and placed in the water bath at 35°C.

Note

If it is necessary to use dried yeast, mix 5g dried yeast per 100mL glucose solution and allow it to activate for about 30 minutes before setting up the experiment.

Experiment 2. Influence of Substrate on Rate of Respiration of Yeast

Follow the procedure to set up 5 respirometers, each with 10mL of a different substrate. Label stopper tops with waterproof pen. Incubate at 35°C in a water bath.

Suggested substrates:

tap water only

glucose solutions, 5%, 10% and 20%

sucrose solutions

other sugar solutions as available

fruit juices, fresh or commercially available;

students may like to bring juices to try and the effect of preservatives could be tested.

Experiment 3. Influence of Presence of Other Substances

Follow the procedure to set up the required number of respirometers, each with yeast and 10mL of 10% glucose solution. Add the substance you wish to test, at different concentrations. Shake well. Label the stopper with waterproof ink. Incubate at 35°C in water bath.

Suggested substances to try:

5mL of sodium fluoride solution of 0.5M and 0.05M sodium chloride solution, as above

detergent, 1 drop, 10 drops, 2mL

disinfectant, as above

pH, add drops of dilute acid or alkali to give a range of pH.

Students may suggest testing other substances which might influence the 'well-being' of micro-organisms. In each case a control should be set up, containing yeast, glucose and a volume of water equal to the volume of solution used in one of the experimental test tubes.

GROWING PLANKTON (SEN 1980, Vol. 29. No. 4)
Harold Lea, Sydney Teachers College.

Plankton can be quickly grown by pouring sea water over some mud freshly collected from underneath mangroves. Add about 0.2g of Aquasol or other 'complete' fertiliser to every 100 mL of sea water and place in a covered beaker about 15cm from a 40 watt electric light bulb. The light is kept on continuously for 4 days, at which time an abundance of zoo-and phytoplankton, including diatoms, are visible on microscopic examination.

A similar technique using a) fresh tap water and garden soil and b) water from a non-saline permanent pond, was used. In both cases an abundance of phytoplankton developed after 7 days, but only scant zooplankton. Omitting Aquasol resulted in a smaller but significant amount of phytoplankton visible macroscopically on the surface of the beaker and in suspension.

Where the technique of adding Aquasol and light from a 40 watt bulb was used with water from a permanent fresh water pond containing abundant suspended organic matter, abundant phyto- and zooplankton resulted.

WEIGHING A CUCUMBER AS IT GROWS (SEN 1981 Vol. 30 No. 2)
P.W. Freeland, Science Review 59, March 1977

Figure 1. shows how an automatic top-pan balance was used to record continuous weight changes in a growing cucumber, attached to a pot-grown plant. Seeds of the greenhouse variety Topsy were sown in large pots during the first week of April; seedlings were grown in an unheated greenhouse until mid-June, then transferred to the laboratory as soon as young fruits had developed.

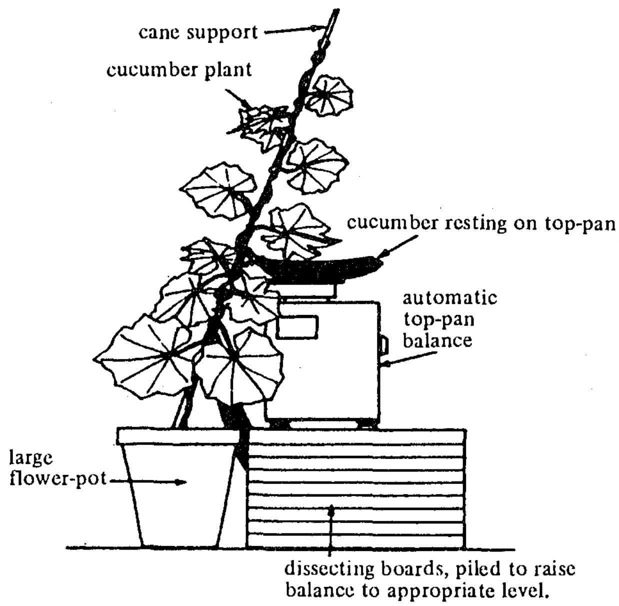


Figure 1. Arrangement of cucumber plant and top-pan balance

Each fruit, suspended from the plant by its pedicel, was placed on the top-pan and its weight recorded. The process was repeated daily over a period of 14-21 days, until the fruits were ready for cutting. In addition, weight changes in large cucumbers, exceeding 150g, were monitored on an hourly basis from 9.00 a.m. until 4.00 p.m. over a period of seven days. It was found that large fruits added anything from 0.7 to 1.9g per hour and that there was a periodic variation in these additions, with the largest gain occurring between 10.00am and noon. A typical set of results is shown in Figure 2. It should be noted, however, that weights shown on the graph are not the true weight of the fruit, as some of that weight is always borne by the pedicel.

This simple technique, apart from being applicable to other pot-grown plants such as tomatoes, peppers, runner beans, french beans and some cultivars of pea, can be used to investigate the effects of environmental factors, or chemical substances, on the growth rate of fruits. Alternatively it can be used to compare growth rates in different cultivars or species.

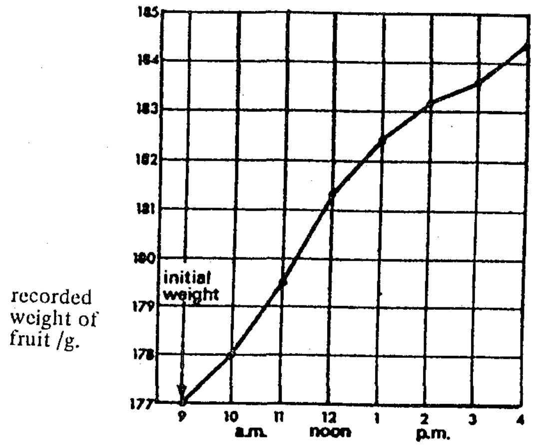


Figure 2. Changes in the weight of a large cucumber over a period of seven hours.

A SIMPLE EXPERIMENT TO DEMONSTRATE CATALASE ACTIVITY

(SEN 1981 Vol. 30 No. 2)

Damaris Cordery

Introduction

Catalase is a particularly active enzyme found in cells of almost all aerobic organisms, especially in animal tissues such as liver, kidney and blood. It consists of protein plus an iron-porphyrin group containing four atoms of iron per molecule. Its action is easily demonstrated qualitatively by adding hydrogen peroxide to liver extract; molecular oxygen is instantly liberated.

$$2H_2O \rightarrow 2H_2O + O_2$$

1mg of pure catalase liberates 2.740 litres of oxygen per hour at 0^oC

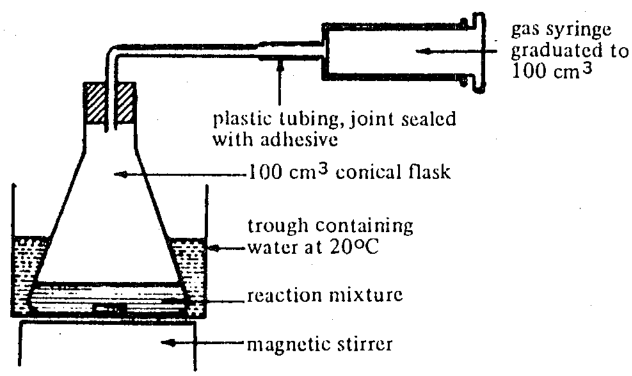


Figure 1.

Figure 1. shows the apparatus used to estimate the volume of gas evolved by the addition of liver extract to hydrogen peroxide.

Method

1. Preparation of the extract. Place about 25g of ox liver in a small coffee grinder for 5 minutes. Weigh out 1g of the homogenate, dilute with $100cm^3$ 0.9% sodium chloride solution and mix thoroughly.

2. Prepare 3% hydrogen peroxide by diluting 30% hydrogen peroxide.
3. Pipette $10cm^3$ 3% hydrogen peroxide into the conical flask, seal the apparatus and test for air leakages.
4. Adjust the temperature of the water bath to 20^oC. This approximates to room temperature and eliminates constant adjustment of the water temperature during the experiment.
5. Switch on the magnetic stirrer to rotate at moderate speed. By clamping the flask in the same position relative to the platform during each trial, errors because of different speeds of stirring are eliminated.
6. Invert the flask containing the extract three times to ensure thorough mixing and take the sample from the centre of the flask with a $1cm^3$ syringe.
7. Introduce the sample into the conical flask via the syringe and immediately seal the apparatus. At the same time, switch on the stop watch and record the volume of gas in the gas syringe at intervals of 30 seconds up to 5 minutes.
8. Repeat the procedure three times for each volume of extract, washing the flask containing the reaction mixture thoroughly between each trial.

Figure 2 gives a graphical summary of the results obtained.

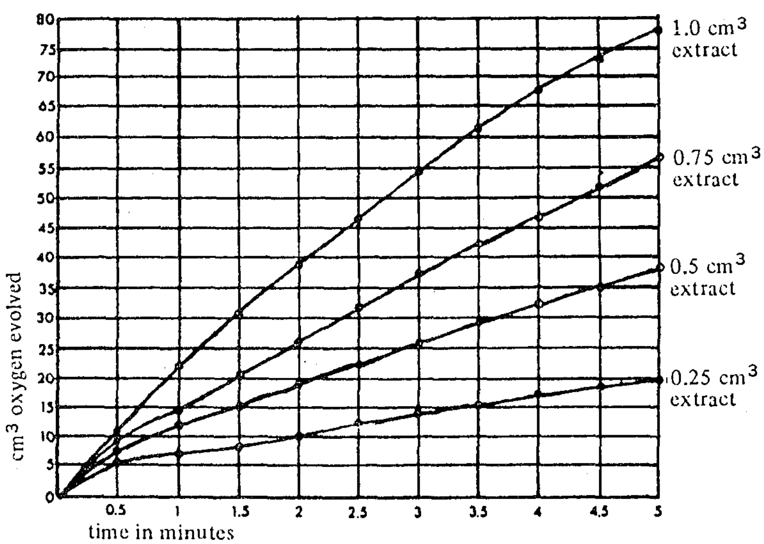


Figure 2. Graph of volume of oxygen evolved vs. time

Discussion

The activity of catalase makes it a suitable enzyme for study in schools. Qualitative demonstrations can lead to quantitative measurements of oxygen evolved. Sufficient oxygen is liberated for readings accurate to within 1cm^3 to be taken. Reproducible results are obtained with the same liver extract. It was hoped by making the experiment a comparative one to eliminate errors due to variations in liver, length of storage time, etc. Ideally, liver from freshly killed animals would be used but this is not obtainable in most schools. It was found that if the homogenate was frozen for a week before carrying out the experiment, consistent results were still obtained.

The use of a syringe to introduce the extract sample allows minimum escape of oxygen. This is important as catalysis begins immediately.

The experiment could be adapted to compare enzyme activity under different conditions, for example pH, temperature and in the presence of non-competitive and competitive inhibitors.

The apparatus can also be used to demonstrate catalase activity in other types of animal tissues such as blood. If 1cm^3 blood is diluted with 0.9 cm^3 0.9% sodium chloride solution and 0.5 cm^3 samples are used for each trial, good results can be obtained.

THE USE OF ILLUSTRATED KEYS FOR CLASSIFICATION IN SCHOOLS

(SEN 1983, Vol. 32 No. 2)

Leonie M. Kemp, Education Officer, Royal Botanic Gardens

Introduction

Two biological keys, using mainly diagrams and few words, were developed at the Royal Botanic Gardens, Sydney, for use with travelling kit materials. Results from trials of over 200 senior students showed the keys to be easier to use than similar worded keys in identifying a family of plants down to the genus level. Fewer mistakes were made using illustrated keys. The keys were also of particular use with ESL students, aiding language development with the use of words and diagrams. This type of key could also be used with junior high school students.

Use of Illustrated Keys

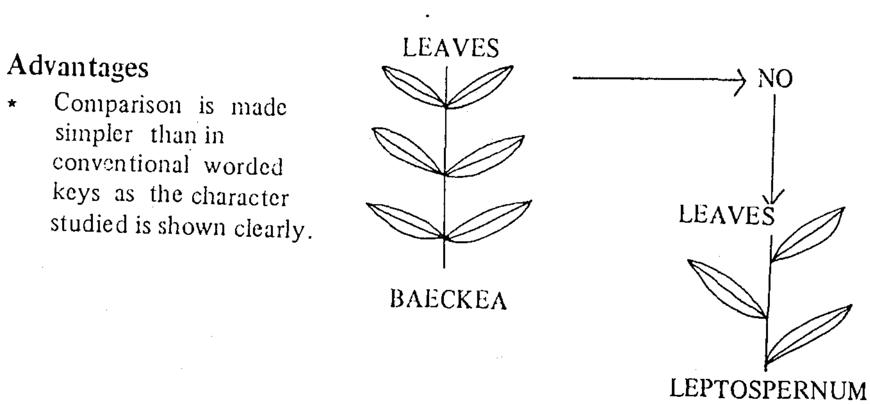
Teachers could develop their own illustrated keys to identify some of the plants growing in the school grounds. Only those features that can be clearly shown in diagrams should be used. Similar keys could be developed to identify some of the animals found near the school grounds. The key could also be used to identify non-living objects.

The keys can also be used to develop language with ESL students. The name of the illustrated feature could be added to the key.

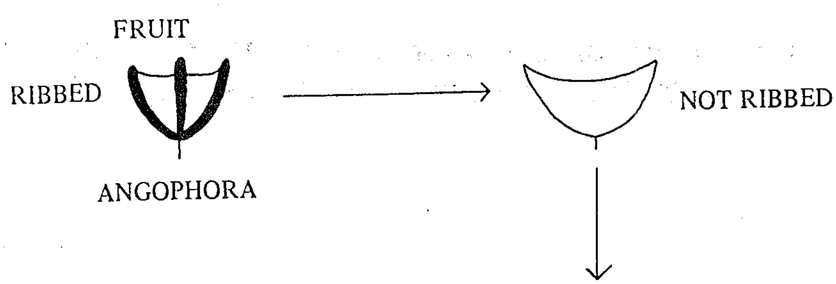
To develop the ability to compare and contrast, students can practise making simple keys using diagrams to distinguish between 3 or 4 different plant, animal or non-living specimens.

Advantages

- Comparison is made simpler than in conventional worded keys as the character studied is shown clearly.



* The key is quicker to use as not as much reading is involved.
* With the use of diagrams, ESL students are not hampered by unfamiliar words. The association of words and diagrams aids learning new languages.



* Fewer errors are made following arrows, compared to conventional keys when following a sequence of numbered steps.
* With fewer errors, more specimens can be identified in the same time available.
* Because of the simplicity of this type of key, it could be used with junior high school students, eg. in distinguishing between major plant or animal groups or non-living objects.
* Because the key is self-guided teachers have more time to correct major student errors or to point out additional features of the specimens.
* Additional senses, such as smell, can be used with the aid of the teacher, eg. the scent of crushed leaves, the feel of bark, salty taste.

A Disadvantage

* Some distinguishing characteristics between a group of specimens cannot be illustrated simply, thus reducing the number of specimens identified by the key.

Conclusion

Because illustrated keys are self-guided, teachers can spend more time with students developing language, correcting major errors and pointing out additional characteristics of the specimens. Their simplicity makes them ideal for use with junior and senior high school students as well as ESL students.

With the use of illustrations, biological terms can be eliminated. The key does not have to be restricted to biological specimens but could be used with non-living objects.

Because of the simplicity of this type of key, teachers could develop their own keys for use with specimens around the school.

Note: The author of this article has indicated that copyright for diagrams rests with the Education Unit of the Royal Botanic Gardens.

NATURAL SELECTION - A BOARD GAME (SEN 1983, Vol. 32 No. 2)

Anne Buffier, St Catherine's College, Singleton

Introduction

The following game was created in an effort to make the concept of natural selection easier for students in the lower streams of Years 9 and 10. Since natural selection is a continuous and usually long-term process, (with the exception of, say, some micro-organisms) any first hand observations are beyond the reach of school science classes. Examples are usually far removed from the students own experience, as in the case of the peppered moth, *Biston betularia* and the Galapagos finches.

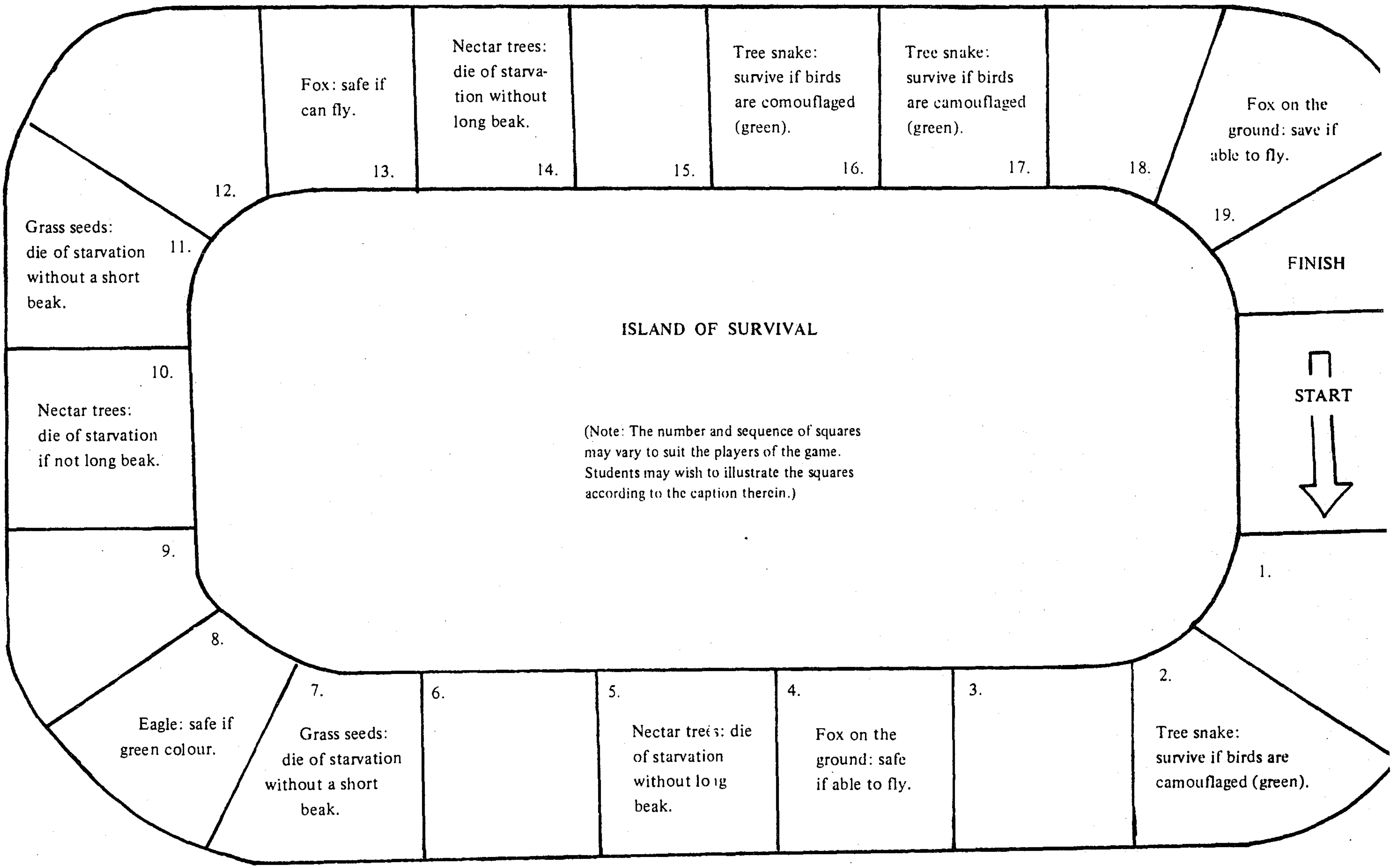
It was felt that if the students could "create" certain organisms AND the habitat in which they live, they might then have a better chance of viewing natural selection as the interaction between organism and environment that it is.

Materials

You will need:

* a sheet of white cardboard
* 30 cards (organism cards)
  (10 of Type A, 10 of Type B, 10 of Type C)
* die and container

Note: Although birds were used by Year 10 at our school, endless variations are possible. It is suggested that the choice of organisms (bird, fish, insect, worm, etc.) and its habitat be left to the students.


ISLAND OF SURVIVAL
(Note: The number and sequence of squares may vary to suit the players of the game. Students may wish to illustrate the squares according to the caption therein.)
START
1.
2.
Tree snake: survive if birds are camouflaged (green).
3.
4.
Fox on the ground: safe if able to fly.
5.
Nectar trees: die of starvation without long beak.
6.
7.
Grass seeds: die of starvation without a short beak.
8.
Eagle: safe if green colour.
9.
10.
Nectar trees: die of starvation if not long beak.
11.
Grass seeds: die of starvation without a short beak.
12.
13.
Fox: safe if can fly.
14.
Nectar trees: die of starva-tion without long beak.
15.
16.
Tree snake: survive if birds are comouflaged (green).
17.
Tree snake: survive if birds are camouflaged (green).
18.
19.
Fox on the ground: save if able to fly.
FINISH

Method

Step 1: Students choose their organisms and decide on the kind of habitat it will live in. A circuit is drawn up on the cardboard with most squares illustrating some feature of their habitat.

Step 2: Students draw up their three types of organism cards. (10 of each.)

TYPE A	Camouflaged	Adapted for Escape from predators	Adapted for Obtaining main food source of habitat
TYPE B	Camouflaged	NO adaptation	Adapted for obtaining main food source of habitat
TYPE C	NOT camouflaged	Adapted for escape from predators	Not adapted for obtaining food

Step 3: Cards are placed face down in the centre of the board.

Step 4: A player selects a card from the top of the pile, throws the die and moves the appropriate number of squares.

Step 5: Birds completing the circuit go back to the bottom of the centre pile.

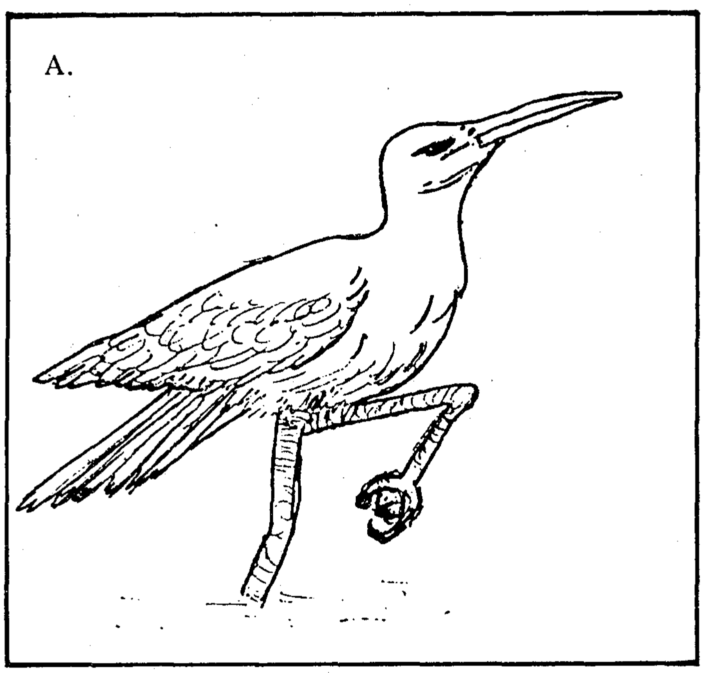
Step 6: Players score points each time one of their cards COMPLETES the circuit.

Step 7: Birds which are 'killed' along the way are put out of play. A player must then choose another card.

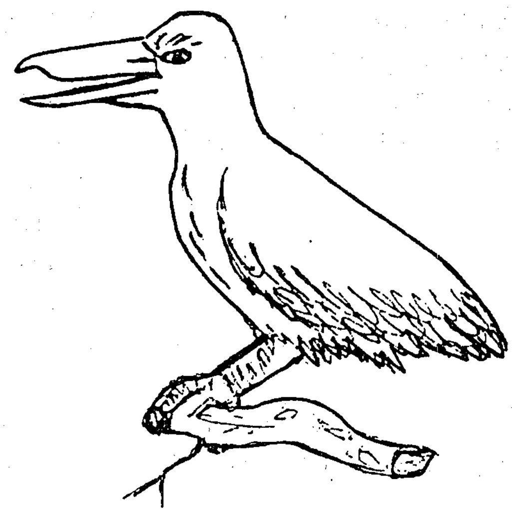
Conclusion
Students soon realise which card type is 'naturally selected' by the conditions of their habitat. (These are the kinds which score their points!) A lot of worthwhile discussion can be generated in follow up.

Example of Bird Cards

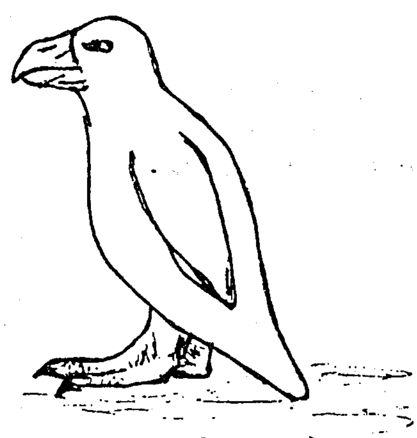
TYPE A	Dull green	flies	long beak
TYPE B	Dull green	cannot fly	long beak
TYPE C	Yellow	flies	short beak



B.



C.



ACTIVITIES WITH THE MICROSCOPE (SEN 1983, Vol. 32 No. 3)

Phil Johnson, Evans HS

A. Suitable Material for Use With School Students

MATERIAL	FEATURES Reasons for Observations	METHOD
Tiny letters 'p, 'e' cut from paper	Shows inverted image. Gives practice in focussing under L.P. Slide gives notion of magnification (+100)	Place on slide without cover-slip. Slightly dampen so that letters stick in position. Practise moving slide while observ-ing. L.P. only
Starch grains from potato, soaked beans or wheat grains	Simple preparation. Shows concentric rings under H.P. Practice in adding stain.	Scrape cut surface. Tran-sfer milky smear to slide Stain blue with iodine after initial observation L.P. and H.P.
Tomato, potato or watermelon, fleshy tissue	Easy to see cell wall, round, loosely packed cells, large size.	Thin sliver on slide (no cover slip). Hold up to light. Use hand lens for cell out-lines. Keep moist.
Onion epidermis i.e. skin from inside fleshy bulb	Regular shaped brick-like cells. Vacuoles and nucleus can be seen in some.	Hand lens first, then L.P. and H.P. Make diagram. Stain with red eosin.

Tradescantia epidermis, from lower leaf surface (geranium leaf is also suitable)	Irregular shaped epidermal cells (like crazy paving) with scattered stomates, bean shaped stomates plus chloroplasts.	Allow leaf to wilt slightly before stripping off epidermis piece. Mount in water Use L.P. and H.P. No stain needed.
Elodea (water weed) -edge cells of leaf	Chloroplasts easy to see. If healthy some will be moving within cell, indicating streaming of cytoplasm.	Mount whole leaf taken from near stem tip. Water only. L.P. H.P
Spirogyra, an algae pond scum, green slime.	Ribbon-like spiral chloroplast. Chain of cells joined end to end. Spiral chloroplasts enable depth of field to be judged.	Mount in water only, using dissecting needle to break strands and arrange them on slide.
Transverse section (T.S.) of young stem, e.g. geranium balsam, tomato, pumpkin or celery stalk or rhubarb stalk.	Ring of vascular bundles (veins) of conducting tissue. Set in ground tissue and surrounded by outer epidermis. (Balsam has spicules scattered throughout.)	Thin section mounted in water and eosin to stain vascular bundles. Can be viewed with hand lens, then L.P.
Hairs, pumpkin family (*cucurbita*) or purple hairs of stamens of *tradescantia* flowers.	Rows of cells tapering from base. Vacuoles and nucleus can be seen (especially in those near the base)	Mount in water L.P., H.P. for a cell near base.

Human cheek cells (from internal lining epithelium)	Simple shapes. Nucleus and granulated cytoplasm.	Mount in 0.65% salt solution, (water will do for quick viewing), add eosin. L.P. H.P. Take a small scraping with a spatula.
Unicellular organisms of hay infusions, pond water on surface of waterweeds at base of aquarium.	Variety of ciliates, flagellates, diatoms. Succession of organisms in hay infusions.	Drop of culture medium under L.P. (Discard if no organisms are readily visible.) Movement may be slowed down with methyl cellulose or saliva.

B. Dark Field Technique

Dark field technique aims at improving the contrast of specimen features. The technique is at its best when small transparent objects are to be viewed. They are rendered much easier to perceive because they are made to appear bright against a dark background.

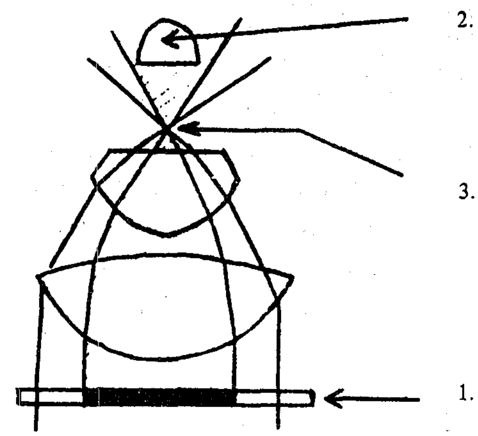
Through the use of a dark field condenser the normal pattern of light and dark are reversed. The background now appears dark and fine structures are seen as pinpoints of light. However, with this technique resolving power is reduced. (This method needs to be used in conjunction with normal microscopic procedures so that a student can gain a more realistic impression of the tissue.)

Essentially, direct light must not reach the objective, but the objective must be able to collect as much as possible of the light scattered by the specimen.

1. Filter holder with central opaque patch. A hollow cone of light is produced.

2. Objective which is inside the dark centre of the cone receives no direct light, i.e. darkfield.

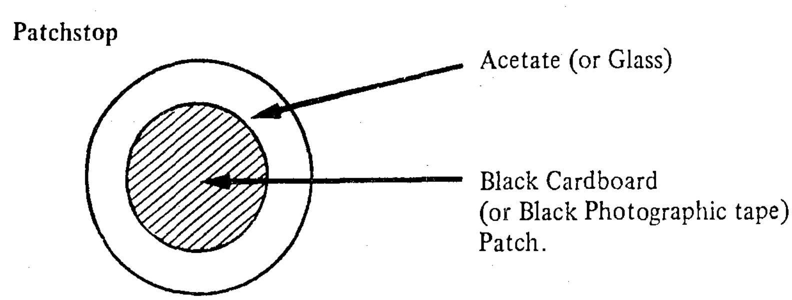
3. Specimen at apex of hollow cone of light reflects and diffracts light which objective can pick up, eg. bright pinpoints of light.



As soon as the objective Numeral Aperture (NA) exceeds the aperture of the cone, direct rays enter the objective and a darkfield effect cannot be obtained. For objectives with Numeral Aperture less than 0.7, an ordinary 1.25 NA condenser can be used to produce darkfield by the addition of a 'patchstop' in the filter of the condenser.

Producing the Patchstop

1. Remove the blue filter from the microscope filter holder.
2. Trace the shape of the filter onto a piece of acetate sheet and cut out the disc of acetate.
3. Check that the disc fits the filter holder.
4. Trace the outline of a one cent coin onto some black paper and cut out the paper disc.
5. Paste the paper disc on the middle of the acetate disc to make the patchstop. (Acetone works as paste.)
6. Place your patchstop on the filter holder.



Procedure

1. Use the blue filter on the lamp and in the microscope holder. Place the test slide of *Pleurosignma angulatum* of your slide of pond water on the stage. You may need to use some methyl cellulose to slow down the organisms in pond water. Focus on the organisms.
2. Remove the slide and place a drop of oil on the top lens of the sub-stage condenser.
3. Replace the slide and raise the condenser until the oil touches the slide.
4. Open the iris diaphragm fully and then view under high power.

Additional Comments

1. Slides and coverslip must be clean. Glare produced by dust or grease reduces contrast of the image.
2. The specimen must be lit at the apex of the cone, i.e. it cannot be too thick or the condenser will not focus the cone of the specimen and no bright points of light will be produced.
3. The patchstop must be carefully centred otherwise there will be uneven intensity of light.
4. A 35mm slide projector can be used as the light source if the image is dark.

This technique is used to bring out spectacular detail in specimens which otherwise have little or no contrast.

C CARE OF THE MICROSCOPE

1. Cleaning dust off lenses

a) Remove the dust with a camera blower. Ensure that only a blower with a dust cover is used. Alternatively, just 'huff' on the lens.

b) The dust can be wiped off (if no grease is present) with one of the following:
- a well washed handkerchief
- cotton buds on an orange stick.

(Cotton buds are 100% cotton, but cotton wool is up to 80% synthetic and should not be used. Orange sticks, which are obtained from jewellers have no 'grease' in their wood.)

2. Cleaning grease off lenses

The best solvent to use is Shell X-55. This is non-toxic and is obtainable from Olympus. Special dispensing bottles can be obtained from Anax for approximately $5.

Other solvents which are satisfactory are:

- Windex used with cotton buds
- OPSM Spectacle Lens Cleaner.

3. Removing immersion oil

a) Initially wipe both objective and condenser with Kleenex or Bowscot Microwipes. The latter are more lint free and it is not necessary to wipe as hard.

Lens tissues are good but are not absorptive enough.

Whatever is used, always dispose of the top sheet which has been collecting dust and chalk.

4. Identifying the position of grit

a) Eyepiece: Check by rotating the eyepiece. If the grit moves then rotate top end against bottom end to establish whether it is on the bottom or top lens of the eyepiece.

b) If a square of the ground glass is placed in the system and the grit is still visible, the grit must be on your side of the glass.

Never clean a clean lens.

Never use a solvent unless grease is present.

5. The iris diaphragm

Never lubricate the leaves of the iris diaphragm with oil or grease as the leaves will adhere. Rub a 4B pencil (graphite) on the leaves to 'free' their movement.

N.B. Major problems with other parts of the microscope should not be dealt with by anyone other than a qualified technician.

D PHOTOMICROSCOPY - PHOTOGRAPHY THROUGH THE MICROSCOPE

Photomicrographs similar to those supplied to schools as a strip film may be taken using the microscope issued to schools. A single lens reflex camera with through-the-lens metering makes the task easy. The skill lies in the use of the microscope rather than in photographic expertise.

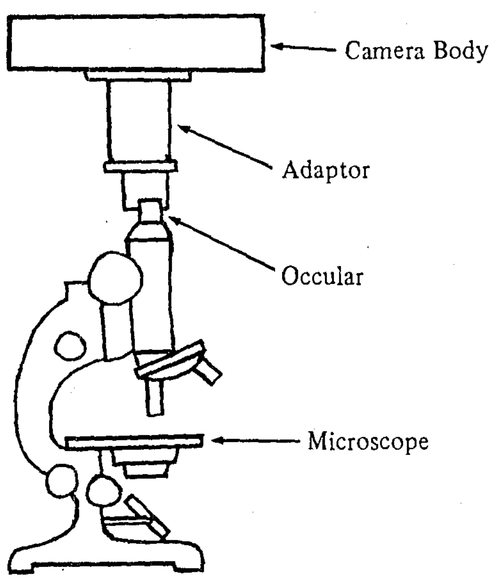
Usefulness

The advantage of using a camera to record data and observations are:

1. The student has a permanent record for notes and/or measurements.
2. The teacher is able to ensure that the student has observed the required features of the slide.
3. The best slides produced by members of the class can be shown to and discussed by the entire class.
4. A record of slides produced can be built up by the teacher for use in the following years.

What is needed

1. A 35mm SLR camera. This needs to have a through-the-lens metering. Other types of camera can be used but will require a trial and error approach.
2. A microscope of a type currently issued to schools.
3. A microscope adaptor. The adaptor needs to fit the camera when the lens is removed and be able to be mounted on a school microscope. You may have to purchase this piece of equipment yourself. They cost around $50.
4. Artificial light Ektachrome film - EPY 135.
5. One blue filter for microscope. (Needed to remove yellow tinge from light.)



GENERAL SET-UP

Setting up the Equipment

1. The adaptor is fitted to the microscope by removing the eyepiece, fitting the adaptor over the barrel of the microscope and replacing the eyepiece. The 10X eyepiece gives the best results as it forms an image which completely fills a 35mm negative.
2. The camera body is now fitted to the adaptor.
3. A suitable source of light is provided by a slide projector. A piece of ground glass between the projector and the microcope acts as a diffuser. The iris diaphragm of the condenser can be used to control light intensity. The diaphragm is adjusted so that the metering system indicates the correct intensity. If a transformer is used the setting once set should not be changed.
4. Colour film can be used for almost any material. Suitable films will have an ASA rating of less than 125, where a slide projector is used as the source of light. These films have a finer grain which permits further enlargement. If artificial light film is used a blue filter should be used on the microscope.

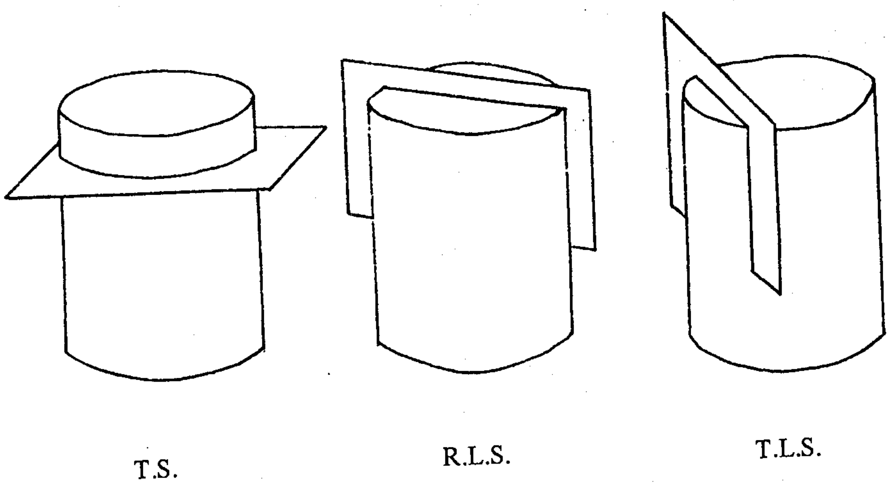
Problems

1. In some cameras the ground glass screen used for focussing the image is rough. This makes the image detail poor but only in the image which must be used for focussing. The photomicrograph will turn out fine. The Olympus OM has a special clear focussing screen.
2. The edges of the slide may be out of focus. This is due to the convex lens in the objective and is more noticeable at high magnification.
3. The light may not be evenly distributed with the edges darker than the centre. This is also due to the convex lens in the objective.
4. The circular field of view of the microscope can result in dark corners in the slide. This is more noticeable at low magnification.

E. SECTIONING

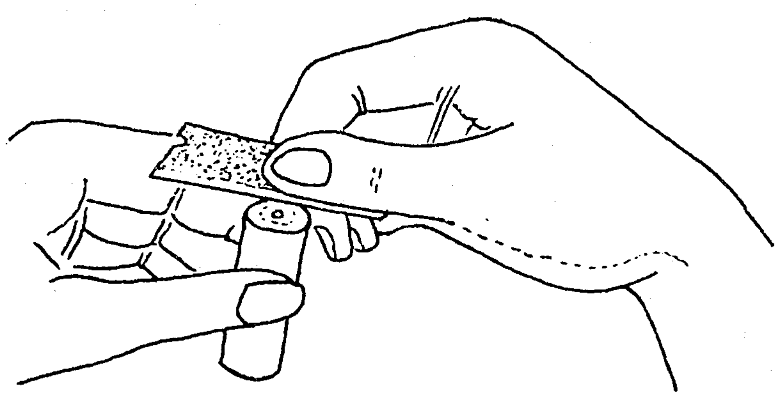
The structure of plant organs such as roots, stems and leaves can be determined by cutting sections, staining and examining them under the microscope.

For general purposes, the most useful sections are:



Cutting Transverse Sections

1. From thick material:
   a) Take a piece or organ about 2cm long; carefully make one transverse cut. This gives you a 'true' surface to cut from.
   b) Hold the specimen upright firmly between your thumb and forefinger and cut thin slices from the surface using a **new** single-edged razor blade. Cut towards you.



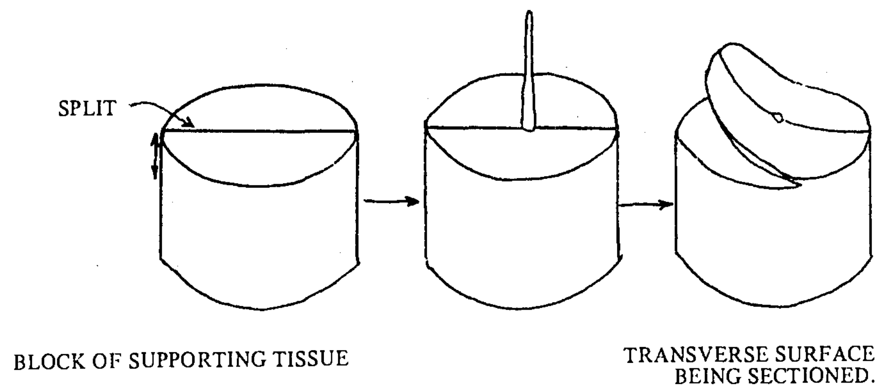
   c) Keep the blade and specimen wet during sectioning.
   d) Transfer the sections to water (using a fine brush) as you cut them. Make several sections and then choose the thinnest for study.
   e) The transverse surface will have to be retrimmed frequently to avoid oblique sections which are

totally unsuitable. (In an oblique section the cell outlines are not clearly defined and will often appear as parallel streaks, making interpretation extremely difficult.)

2. From thin material:

Method 1

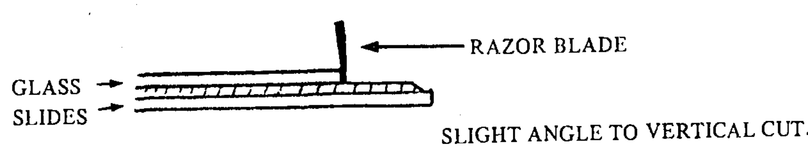
a) Prepare a small block of supporting tissue (piece of carrot root, potato tuber or foam).
b) Split the block or remove a narrow wedge of tissue from the block.
c) Place the specimen to be sectioned in the supporting block.
d) Hold the block firmly and section **both** it and the specimen.



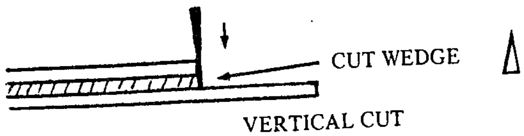
* Entire sections are not necessary. Since plant organs are often symmetrical, a portion of the organ should allow you to interpret its structure.

Method 2

a) Place the material to be sectioned between two glass slides.
b) Move the top slide back to expose the material and then cut at a slight angle to the vertical.

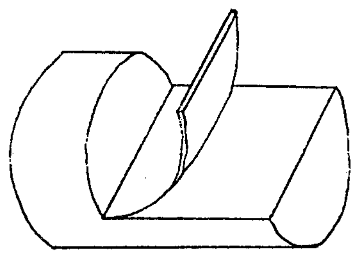


c) Make a second cut perpendicular to the slide. This will form a wedge of material which should be very thin on one edge.

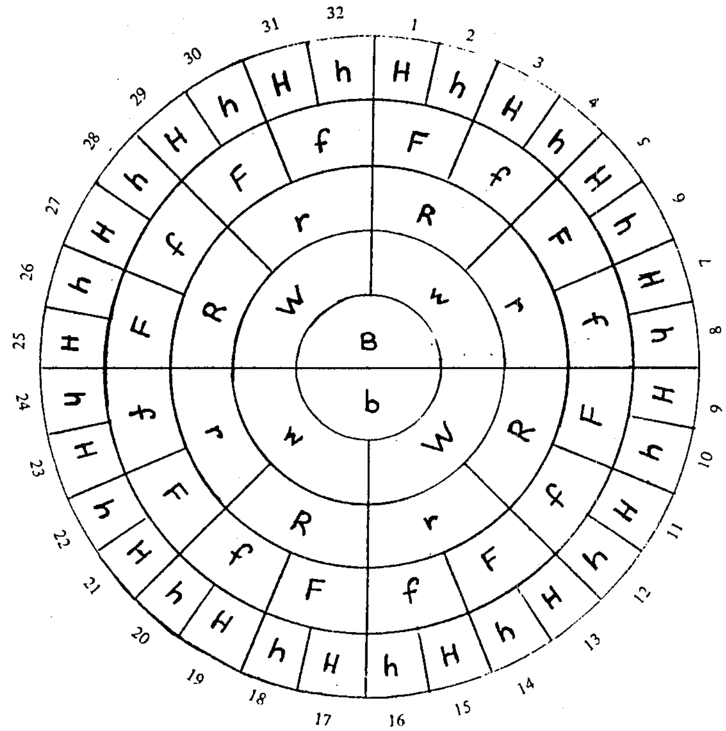


Cutting a Longitudinal Section

Prepare a longitudinal surface as shown in the figure and section from this surface, retrimming frequently.



GENETICS WHEEL (SEN 1983, Vol. 32 No. 4)



KEY

B = non-blue eyes; b = blue eyes.
W = widow's peak; w = straight hairline.
R = can roll tongue; r = cannot roll tongue.
F = unfused ear lobes; f = fused ear lobes.
H = hair between first and second finger joints;
h = no hair between first and second finger joints.

Start at the centre of the wheel. Shade in the semi-circle that describes the characteristic that you have. From the shaded area move to the area in the next circle that applies to you and shade it. Continue this process until you have shaded a section of the outermost circle.

Some Questions

1. What number did you reach at the outside of the wheel?
2. How many people reached the same number as you?
3. Which number did most people in the class end up at?
4. We have considered only five characteristics of people. Do you think fewer people would end up at the same number if fewer characteristics were considered? Why?
5. Can you think of cases where two people do have the same form of all their features? Why are they so similar?

THE KIDNEY - A SCRIPTED ROLE PLAY (SEN 1984, Vol. 33. No. 4)
Julie Crowley, North Sydney PSC

We all learn best by active involvement in the learning process. Here is a role play I have used effectively with senior biology students. It involves a minimum of preparation and no movement of classroom equipment.

Equipment

1. Cards entitled: -
   red blood cell
   large protein molecule
   water molecule
   sodium ion
   amino acid
   nitrogenous waste material.

2. Signs to set the scene, to be arranged around the room in a logical sequence such as:
   renal artery
   to the nephron
   glomerulus
   to loop of Henle
   ureter, to the bladder
   renal vein.

3. Script
   I am ---------, travelling in the blood. I travel in the renal artery and enter the kidney. Finally I come to a nephron and into a glomerulus.

   Ending 1. I stay in the capillary and finally join the renal vein and leave the kidney.
   Ending 2. I am filtered out of the blood and go long a long twisted tube. The tube goes into the loop of Henle and I am reabsorbed into the capillaries. I finally reach the renal vein and leave the kidney.
   Ending 3. I am filtered out of the blood and go along a long twisted tube. The tube goes into the loop of Henle and I join a collecting tube which finally becomes the ureter. The ureter takes me to the bladder. I pass out of the body as urine.

Procedure
One student collects a card and enters the 'kidney'. As the student reads their script they move around the 'kidney'. The role play involves a choice of three endings. The student must decide which ending to choose for their card and so must be actively involved in the experience.

The rest of the class can follow on their scripts. The role play can be stopped so that other students can think about which ending they would choose and then check answers at the conclusion.

I feel that it reinforces the exercise to have the students moving to the appropriate part of the room as they read their script. Students could make up their own scripts on the action of other organs for homework.

CRAFTY SCIENCE. THE ART AND CRAFT AND SCIENCE SHOW? (SEN 1986, Vol. 35 No. 2)
Margaret Ruckert

For any craft there is generally a large back up of scientific facts and procedures. In pottery, a knowledge and appreciation of the type of clay, together with the different effects of chemical glazes and firing, is used to create the finished product. The potter is both a material scientist and artist; cause and effect are constantly being monitored.

We hear about a revival of interest in the crafts. Local art and craft shows are popular. But have the crafts ever been neglected? I suspect the human need for self-expression and the satisfaction gained from mastery over materials is always present. How can we revive dormant student desires and use them in active learning situations in ecology, for example?

The HSC Biology syllabus section, Ecology, states one of its aims is 'to develop an appreciation of the wide variety of ecosystems'. I felt students were bored of botanical names and bewildered at the huge scale of plant communities. So I decided to reduce the complexity to a size that could be appreciated - into a basket!

The Bush Basket

Materials

* small basket - mine was 8cm diameter
* 'mechanic' to fill it, e.g. Secbrick or Oasis
* optional chicken wire, piece of thin wire
* plant species
* ribbon and piece of paper for scroll.

Before the Lesson

1. Collect samples of the major species that occur in the dry sclerophyll forest, e.g. Eucalyptus fruits and flowers, Banksia leaves (cones and leaves of some species are too large to use in the basket but could be demonstrated), Leptspermum sp., Acacia or daisy sp., Melaleuca or Callistemon spikes, bracken fern. For simplicity, have only one white flower, one yellow flower, etc. or students will get them mixed up.

CR

2. Air dry by hanging upside down for two weeks. Buy suitable specimens for use from homemaker shops. The basket looks drab with mainly brown plants, so buy some yellow daisy anyway.
3. Cut Secbrick to fit the basket and slightly higher than the top of it and push down firmly. For larger baskets a piece of chicken wire on the top, held down by a wire wrapped around both handles will keep the 'mechanic' in place better.

The Lesson

1. Describe the dry sclerophyll environment and illustrate with large specimens of the dried plants. Discuss adaptive features. Discuss the plan of the basket and draw the plan on the board.

Teacher Demonstration

1. Have a slightly larger basket than the students. Fill with Secbrick.
2. Start from the outside and place small fern pieces hanging over the edge to hide the 'mechanic'. (If you press the fern you get the best effect.)
3. Make a circle of Eucalyptus fruits next to the edge of the basket. Stems will be about 6cm long.
4. Make a star of daisy or wattle flowers approximately 5cm long.
5. Fill in the points with Leptospermum approximately 7cm long.
6. Place a few spikes of Callistemon radiating out from the centre approximately 12cm long.
7. Assess where more filling is required and use cut down Banksia leaves.

Making the Scroll of Adaptations

Students identify each plant and write up their scroll.

Plan	My Basket
Plant	Adaptations
1.	
2.	
3.	

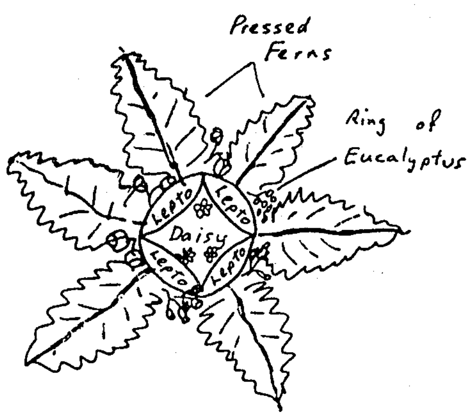
Put in a safe place while the next activity is going on.

Filling the Basket
Make sure students follow the plan or a jumble results. Start from the outside and work in. Tie on the scroll.

Results
Each student has their own piece of Australian 'bush' to study and admire each day. By the end of the lesson you will find them using plant names as they work their basket.

Follow Up - The Endless Collection
Make a collection of seeds, seed pods and fruits. Buy a small box and decorate the lid. Inside place specimens and a list of contents together with relevant botanical explanations.

Note: Of course the more motivated student can start his/her own mini-herbarium using pressed specimens. But how often are they looked at or memorised?



THE ARBITRARY NATURE OF CLASSIFICATION (SEN 1987, Vol. 36 No. 3)
Joan Williams, St Johns Park HS

The following information can be used to cover the section dealing with the arbitrary nature of classification in the Biology syllabus. The detail included here may be more than the minimum requirement for the core but it illustrates the concept well. Additional information for teachers can be found in A Guide to Invertebrate Animals (second edition), Webb, Wallwork and Elgood, Macmillan Education, pp. 104-115, 128-131 and 152-163.

Since classification is designed by humans it is likely to change as new evidence becomes available or if different criteria are used.

Examples

* Fungi

  Fungi were once classified in the plant kingdom because of features like their sedentary habit, cell wall and reproduction by spores. More recently the criteria for being a plant were restricted to organisms containing chloroplasts, thus being autotrophic. This excluded fungi as they are heterotrophs. Fungi are now placed in a kingdom of their own.

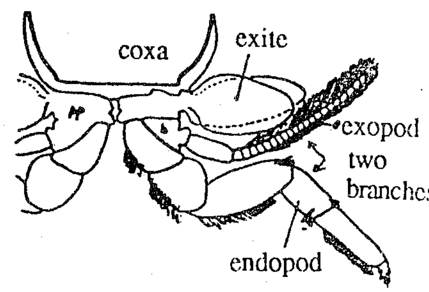
* Arthropods.

  In the last 10 years or so, some biologists have found that evidence from evolutionary trends and embryology suggest that this group should really be three phyla. This difference of opinion is the result of new evidence and the use of different criteria.

PHYLUM	SUB-PHYLUM	EXAMPLE
CRUSTACEA	thoracognatha	*daphnia*, the water flea
	maxillopoda	*lepas*, the barnacle
	malacostraca	*metapenaeus*, the prawn
	ostracoda	
CHELICERATA	class merostomata	*limulus*, the kingcrab
	class arachnida	spiders
	class pycnogonida	sea spiders
UNIRAMIA	onychophora	*peripatus*
	myriapoda	centipedes, millipedes
	hexapoda	insects

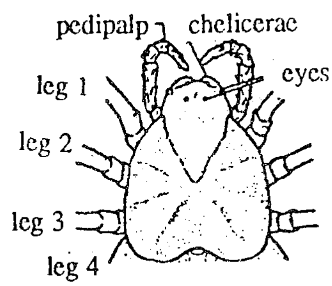
PHYLUM CRUSTACEA
a) mainly aquatic
b) two pairs of antennae
c) branched limbs - usually biramous (two branches)
d) jaws have evolved from the bases of the limbs

pp = protopod
b = basis



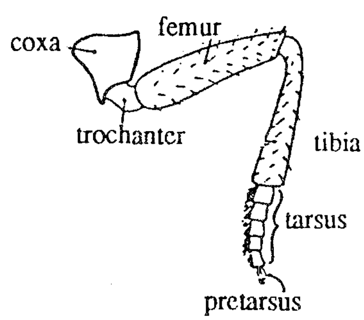
T.S. The biramous limb, the thoracic limb of a crustacean

PHYLUM CHELICERATA
a) no antennae
b) evolved from a biramous limbed ancestor
c) jaws evolved from the bases of the limbs
d) two pairs of feeding appendages attached to the head, i.e. the chelicera and the pedipalp



Dorsal view of head and thorax of a spider

PHYLUM UNIRAMIA
a) mainly terrestrial
b) one pair of antennae
c) limbs are unbranched, i.e. uniramous
d) jaws have evolved from whole limbs
e) embryonic development shows common ancestry with annelids.



The uniramous limb of an insect